MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 2, 2015/2016

PPH 0135 – ELECTRICITY AND MAGNETISM

(All sections / Groups)

11 MARCH 2016
3.00 p.m - 5.00 p.m
(2 Hours)

INSTRUCTIONS TO STUDENT

1. This question paper consists of 7 pages excluding the cover page and the appendices with **FOUR** questions only.
2. Attempt **ALL** questions. Distribution of the marks for each question is given.
3. Please write all your answers in the Answer Booklet provided.
4. All necessary workings must be shown.

Answer **ALL** questions.

Question 1: [15 marks]

a) Consider the electric field lines shown in **Figure Q1 (a)**. State the type of charge (positive or negative) for A and B. Explain your answer.

(3 marks)

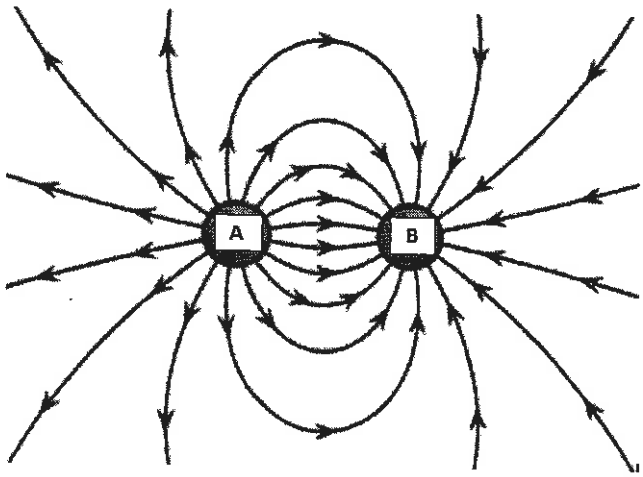

Figure Q1 (a)

b) Copy **Figure Q1 (b)** onto your answer script and sketch the direction of magnetic field of the magnetic bar.

(2 marks)

Figure Q1 (b)

Continued...

c) An electron travels at an angle of 40° with the direction of a magnetic field of 0.4 T in the y-axis and lying in the x-y plane as illustrated in **Figure Q1 (c)**. The velocity of the electron is 3.00×10^6 m/s.

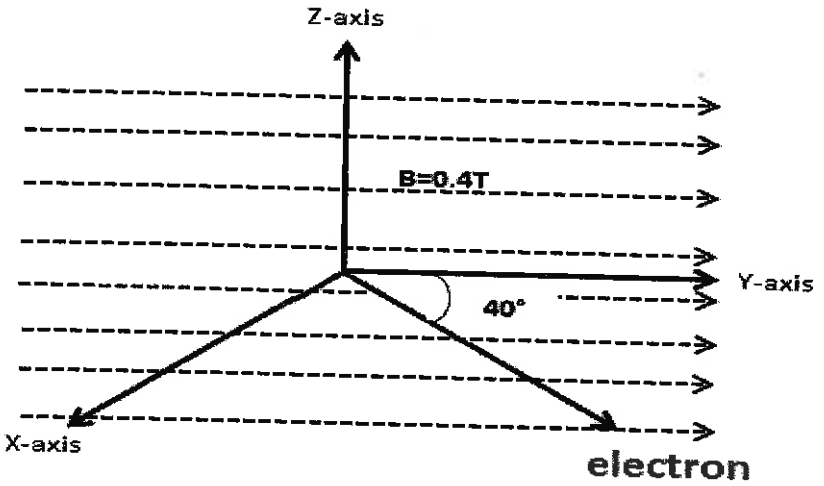

Figure Q1 (c)

i) Calculate the magnitude of the magnetic force on the electron.

(3 marks)

ii) Given that the mass of electron is 9.11×10^{-31} kg, calculate the acceleration experienced by the proton.

(2 marks)

d) **Figure Q1 (d)** below shows three current carrying straight conducting wires placed parallel to each other. Determine the magnitude and direction of net magnetic force acting on wire B of 30 cm long.

(5 marks)

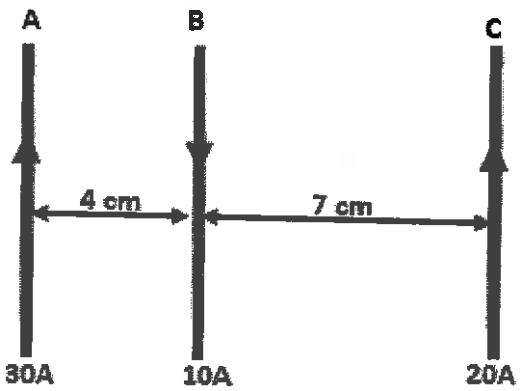

Figure Q1 (d)

Continued...

Question 2: [15 marks]

a) **Figure Q2 (a)** below shows a combination of resistors in a circuit diagram.

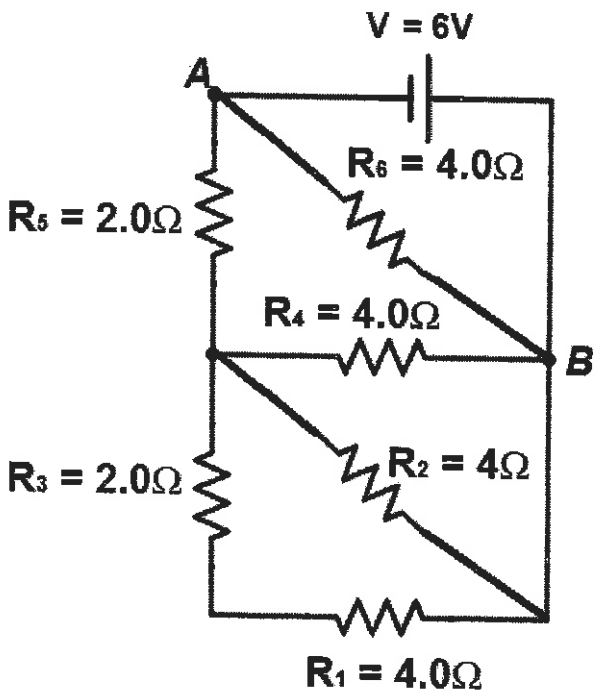

Figure Q2 (a)

i) Calculate the total resistance of the circuit (equivalent resistance between terminals *A* and *B*).

(2.5 marks)

ii) Determine the total current withdrawn from the battery.

(1 mark)

iii) Calculate the current flowing through R_1.

(3.5 marks)

b) A circuit diagram combining three resistors is shown in **Figure Q2 (b)** below.

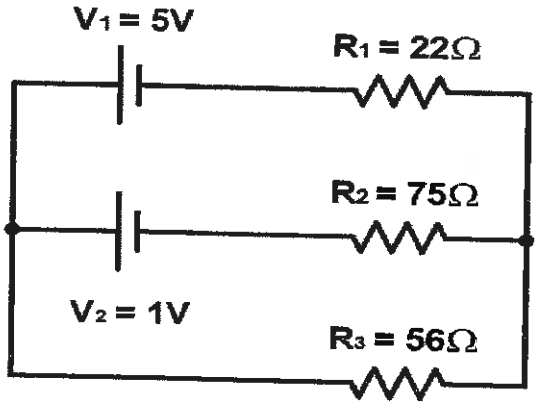

Figure Q2 (b)

i) Use Kirchhoff's Laws to calculate the magnitude and direction of current flowing in R_3.

(4.5 marks)

ii) By taking R_3 as the load resistor (R_L), provide a Thevenin's equivalent circuit and determine the load current.

(3.5 marks)

Continued...

Question 4: [10 marks]

a) Explain the terms "Doping" and "Depletion region".

(2 marks)

b) Explain how the electric field across *pn* junction is created.

(2 marks)

c) Calculate α_{dc}, I_B, I_E, I_C, R_C, and V_{CB} in **Figure Q4(a)** below, given that $\beta_{dc} = 50$ and $V_{CE} = 15.3V$. Assume that the transistor is of germanium type.

(6 marks)

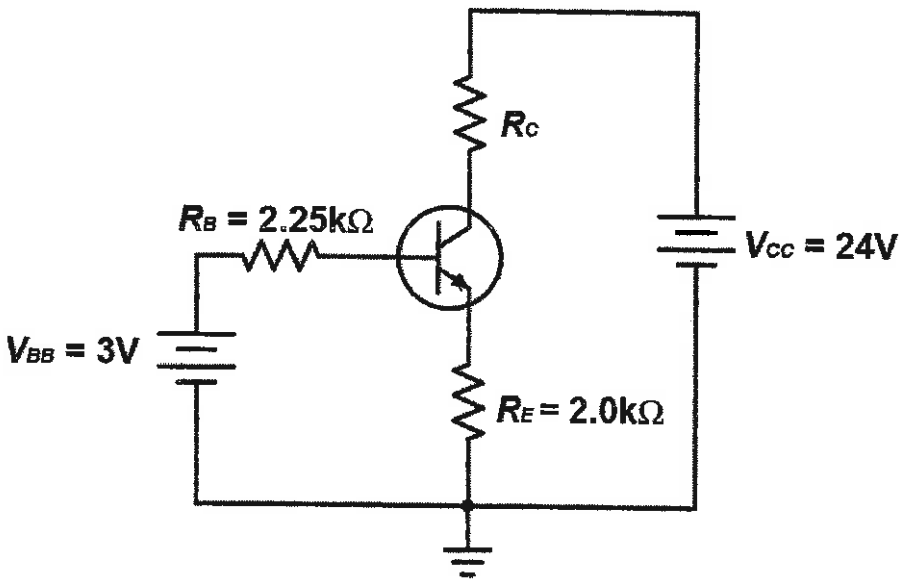

Figure Q4(a)

End of Paper

APPENDIX 1

Physical Constants

Quantity	Symbol	Value
Electron mass	m_e	9.11×10^{-31} kg
Proton mass,	m_p	1.67×10^{-27} kg
Elementary charge	e	1.602×10^{-19} C
Gravitational constant	G	6.67×10^{-11} N.m^2 /kg^2
Gas constant	R	8.314 J/K.mol
Hydrogen ground state	E_o	-13.6 eV
Boltzmann's constant	k_B	1.38×10^{-23} J/K
Compton wavelength	λ_c	2.426×10^{-12} m
Planck's constant	h	6.626×10^{-34} J.s
Speed of light in vacuum	c	3.0×10^8 m/s
Rydberg constant	R_H	1.097×10^7 m^{-1}
Acceleration due to gravity,	g	9.81 m /s^2
Atomic mass unit (1u)	u	1.66×10^{-27} kg
Avogadro's number	N_A	6.023×10^{23} mol^{-1}
Threshold of intensity of hearing	I_o	1.0×10^{-12} W /m^2
Coulomb constant	k	8.988×10^9 N m^2 /C^2
Permittivity of free space	ε_o/κ_o	8.85×10^{-12} C^2/N.m^2
Permeability of free space	μ_o	$4\pi \times 10^{-7}$ H/m

Energy equivalent of atomic mass unit:

One atomic mass unit (1.0 u) is equivalent to 931.5 MeV

APPENDIX II

List of formulas

$$A_v = \frac{V_c}{V_b}$$

$$\alpha_{dc} = \frac{\beta_{dc}}{\beta_{dc}+1}$$

$$\beta_{dc} = \frac{\alpha_{dc}}{1-\alpha_{dc}}$$

$$B = \frac{\mu_0 I}{2\pi r}$$

$$B = \mu_0 nI$$

$$\xi = V + Ir$$

$$\xi = blv$$

$$\xi = -N\frac{\Delta\Phi}{\Delta t}$$

$$\xi = -L\frac{dI}{dt}$$

$$\xi = -M\frac{dI}{dt}$$

$$F = BIL\sin\theta$$

$$F = qvB\sin\theta$$

$$\frac{F}{\ell} = \frac{\mu_0 I_1 I_2}{2\pi d}$$

$$f_r = \frac{1}{2\pi\sqrt{LC}}$$

$$I_{tot} = \sqrt{I_R^2 + (I_L - I_C)^2}$$

$$I = neA(v_n + v_p)$$

$$I = nev_d A$$

$$I = I_{max}\sin\omega t$$

$$I_{rms} = \frac{I_{max}}{\sqrt{2}}$$

$$I_x = \left(\frac{R_T}{R_x}\right)I_T$$

$$L = \frac{N\Phi_B}{I}$$

$$L = \frac{\mu_o N^2 A}{l}$$

$$M = \frac{N\Phi_B}{I}$$

$$M = \frac{\mu_o N_1 N_2 A}{l}$$

$$P = IV = I^2R = \frac{V^2}{R}$$

$$P_t = I_{rms}V_{rms}\cos\phi$$

$$P_r = V_{rms}\, I_{rms}\sin\phi$$

$$P_a = I_{rms}^2 Z$$

$$R = \frac{\rho L}{A}$$

$$R = R_0[1+\alpha(T-T_0)]$$

$$R_T = R_1 + R_2 + R_3 + \ldots$$

$$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \ldots$$

$$r = \frac{mv}{Bq}$$

$$\tau = NBIA\sin\theta$$

$$U = \frac{1}{2}LI^2$$

$$U = \frac{1}{2}B^2 A\frac{l}{\mu_o}$$

$$V_H = Bvd$$

$$V = V_{max}\sin\omega t$$

$$V_{rms} = \frac{V_{max}}{\sqrt{2}}$$

$$V_x = \left(\frac{R_x}{R_T}\right)V_S$$

$$X_C = \frac{1}{2\pi fC}$$

$$X_L = 2\pi f L$$

$$Z = \sqrt{R^2 + (X_L - X_C)^2}$$

$$\oint B.dl = \mu_o I$$

$$d\mathbf{B} = \frac{\mu_o I}{4\pi}\frac{d\ell\times\hat{\mathbf{r}}}{r^2}$$

$$\Phi_B = BA\cos\theta$$

$$\cos\phi = \frac{R}{Z}$$

$$\tan\phi = \frac{X_L - X_C}{R}$$